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Observation and Prediction in Ancient Astrology

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Introduction

What role does the observation of astronomical phenomena play in the predictive apparatus of the ancient astronomer/astrologer? This question will be explored by looking at the astrological uses of a family of texts and instruments known as *parapegmata,* and then comparing them with other kinds of astrological text. By contextualizing a given day or date in a larger temporal cycle, these instruments were used for predicting natural phenomena such as weather, and for regulating agricultural practices. This tradition finds parallels in several different omen traditions, common throughout the ancient Mediterranean and Near East, where different kinds of fortuitous events (including astronomical events such as eclipses) frequently had ominous significance. By about the fifth century B.C., however, astronomy had distinguished itself from the other omen traditions by developing methods for predicting even the astronomical events from which its omens were derived. But the very adoption of these new predictive methods served to canonize the timing and character of the astronomical events, which means that the texts and tools of early astronomy became, to some extent, *normative.* Now, in making his predictions, the astronomer/astrologer (in spite of his rhetoric to the contrary) can be seen to be primarily working from texts and instruments, rather than from observations in the natural world.

This means that the actual *sign* observed in making a prediction is no longer a stellar phenomenon. Instead, the stellar phenomenon functions as the sign-in-theory, but no longer in practice, of astrological prediction. The sign-in-practice is now a text, a table, or an instrument

I. Astrometeorology and related practices in the classical world

Astrometeorology is the oldest branch of astronomy/astrology in the Greek tradition. As early as Hesiod (c. 700 B.C.), who is among the earliest of extant Greek authors, we find:

> Fifty days after the solstice,
> at the arrival of the end of the season of weary heat,
> that is the time for mortals to sail. ...
> Then are the winds orderly and the sea propitious.
> *(Op.*, 663 f.)[1]

Here we have a seasonal prediction for weather conducive to navigation, timed according to an astronomical phenomenon. Other kinds of astronomical seasonal markers turn up in an agricultural context:

> At the rising of the Atlas-born Pleiades,
> begin the harvest, and you should plough when they set. *(Op.*, 597-8)

> Urge the slaves to thresh Demeter's sacred corn
> when strong Orion would first appear. *(Op.*, 383-4)

[1] All translations are mine unless otherwise noted.

In the absence of a solar calendar, such observations of the annual risings and settings of the fixed stars allowed the ancient farmer or sailor to situate the current day in the context of the solar year and its seasons. When to plough, when to plant, when to prune, when to harvest, and when it was safest to venture out on the ocean, are all thus indicated by stellar phases rather than, as we would do it, according to a calendar. For example, gardeners in my neighbourhood know not to plant annuals before the Victoria Day long weekend (on or around the 24th of May), but we could equally effectively time this planting using a stellar phase. In the absence of a calendar as effective at tracking the solar year as the Gregorian calendar is, the stellar phases would even be the better choice.

The most well-articulated ancient versions of this kind of practice can be found in Roman agricultural texts like Vergil's *Georgics,* Varro, (both 1st c. B.C.) Columella, and Pliny the Elder (both 1st c. A.D.).[2] But the core of the tradition had already been established by the third or second century B.C. in what became the archetypal tool for actually doing astro-meteorology: something called a *parapegma.*[3]

A parapegma is an instrument for keeping track of temporal cycles of one sort or another. In an *inscriptional parapegma,* holes are drilled in a stone or in a wall, and a peg is moved from one hole to the next each day (this is the origin of the name *parapegma*, from παραπήγνυμι, "to peg beside"). Astronomical, astrological, and/or astrometeorological information is inscribed beside each hole. Looking at a parapegma on a particular day, the reader looks for the peg and reads the accompanying inscription. Thus from day to day, the parapegma *tracks* the astronomical, astrological, and/or

[2] Vergil, *Georgica;* Columella, *Rei rusticæ* XI; Varro, *Rerum rusticarum;* Pliny, *Naturalis historiæ* XVIII.202 f.

[3] I am in the process of publishing a book-length treatment of these texts, including a full catalogue as well as translations of the more obscure parapegmata. See also Lehoux, 2000; Evans, 1998; Rehm, 1941.

astrometeorological cycle.[4] Altogether we have about 60 parapegmata still extant, in various states of preservation ranging from Ptolemy's complete and excessively detailed *Phaseis,* to fragmentary scraps of graffiti.

Let us look at an example. In 1902, fragments of a second- or first-century B.C. marble inscriptional parapegma were excavated in the theatre at Miletus.[5] On them, we see holes (●) for a moveable peg that was shifted from one hole to the next each day, and beside most of the holes, some astronomical and meteorological predictions for that day.

● Capella sets acronychally according to both Philippus and the Egyptians.
● Capella sets in the evening according to the Indian Callaneus. ●
● Aquila rises in the evening according to Euctemon.
● Arcturus sets in the morning and there is a change in the weather according to Euctemon. On this day Aquila rises in the evening also, according to Philippus.[6]

We see here that various sources are cited: Euctemon, Eudoxus, Philippus (probably Philippus of Opus, the student of Plato), the Egyptians, and Callaneus the Indian. In other parapegmata we find attributions to the astronomer Hipparchus of Rhodes (the most important of Ptolemy's Greek predecessors), Meton of Athens and Callippus (both associated with the development of luni-solar cycles), and even to Democritus, Varro, and Caesar

[4] On tracking as the primary function of a parapegma, see Lehoux, 2000, p. 7-8.

[5] Originally published in Diels and Rehm, 1904; See also Rehm, 1904.

[6] My translation here is based on my new edition of the fragments currently under preparation.

(probably Julius, although possibly Germanicus).[7] Such a list begins to give us a sense not only of the wide range of sources drawn on by this tradition, but also of how widespread it was. I have already mentioned Hesiod, Vergil, Columella, and Pliny the Elder in connection with astrometeorology, and without being exhaustive I could add to this list Ptolemy, Aratus, Cicero, Ovid, Petronius, Diodorus Siculus, Galen, the Hippocratic Corpus, Proclus, and Sextus Empiricus. We have here a tradition that would have been familiar to pretty much anyone in antiquity, from poets to farmers, and from scholars to sailors.

The basic technology of the parapegmata was adapted to several different uses in antiquity. In Roman times we begin to see *astrological parapegmata,* nicely exemplified by the *Thermae Traiani Parapegma (fig. 1)*.[8] This was unearthed as a graffito in a Roman house near the baths of Trajan. The house itself had been converted by the Christians into a shrine to Santa Felicita. The only drawing we have of the parapegma was made in the early nineteenth century, and the parapegma itself seems to have disappeared or been destroyed some time shortly after that. A

7 The question of whether the *Caesar* here refers to Julius or Germanicus is an open one. The earliest mention in a parapegma is Ptolemy's *Phaseis* (2nd c. A.D.). This and later parapegmata give no information beyond the name "Caesar." Speculation ultimately rests on a judgment as to the weighting of one of two possibilities: either (a) Julius Caesar, in some kind of connection with his calendar reform, may have left some material that was later incorporated into parapegmata under his name (Pliny seems to hint as much at *NH* XVIII.211), or (b) Germanicus Caesar's translation of Aratus (attested but now lost) may have included (or been related to) new material later incorporated into the parapegmatic tradition.

On the identities of the other astronomers cited in this section, see Lehoux, 2000, p. 20-22. For the otherwise unattested Callaneus the Indian, see Diels and Rehm, 1904, p. 108, n.1; Pingree, 1976, p. 143-4.

8 This particular example dates from the 4th c. A. D., but there are other examples of this type from as early as the 1st c. A.D. (e.g., the *Pompeii Calendar,* published by Della Corte, 1927; see also Degrassi, 1963, vol. XIII.2, p. 305). Figure reproduced from Degrassi, 1963, vol. XIII.2, p. 308-9.

terracotta copy, made either from the original or from the illustration, has turned up in Würzburg, and a plaster cast of this copy was found in Rome in the early 1980's.[9]

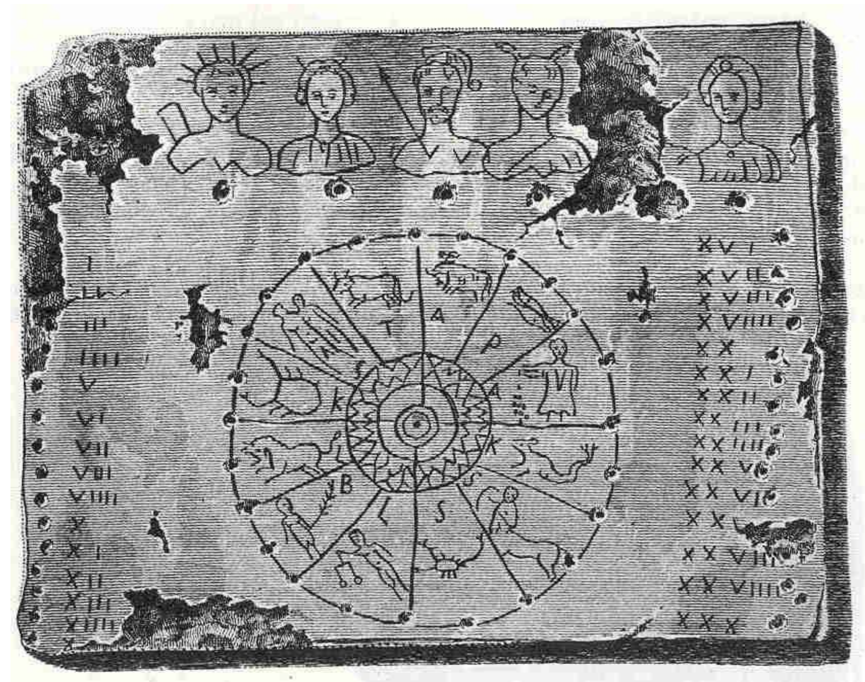

Figure 1: The Thermae Traiani parapegma

Across the top of the parapegma, we see images of five of the seven deities of the astrological week, reading from left to right: a gap (where Saturn should be), then Sol, Luna, Mars, Mercury, a blank for Jupiter (deliberately effaced?), and Venus, in their normal astrological order. The numbers from I-XV run vertically down the left side, and from XVI-XXX down the right. A hole seems to appear just above and to the right of the hole for XXX,

9 See Manicoli, 1981.

but this is probably an artifact of the copyist or else damage to the instrument.[10] In the middle of the parapegma are the signs of the zodiac, with two holes drilled per sign. Reading counter-clockwise from just to the right of the top: Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces. A small fragment of a bone peg was found in one of the holes for Gemini. There were three pegs in use on this kind of parapegma, one to track the days of the week, one to track the motion of either the sun or the moon (it is unclear which) through the signs of the zodiac, and one to keep track of the days of the moon.[11]

Inscriptional parapegmata have generally been seen by modern historians as being the earliest type of astrometeorological parapegma, although I have elsewhere argued that this thesis should be treated with caution, as it is underdetermined by historical evidence.[12] The oldest inscriptional parapegma (the *Ceramicus Parapegma)* is not astrometeorological, and the earliest extant astrometeorological parapegma is literary (the *P. Hibeh Parapegma)*.[13]

10 See Lehoux, 2000. Contrast Erikkson, 1956; Rehm, 'Parapegma', *RE*, col. 1364.

11 The days of the moon are an important astrological indicator of propitious times for certain kinds of activities, not least of which were agricultural tasks, as we see in Pliny *(NH* XVIII.228 and 321) and Vergil *(Georg.,* I.276-286). Vergil, for example, tells us that the seventeenth day of the moon is propitious for planting vines, the ninth lucky for fugitives but unlucky for thieves, and that the fifth day is unlucky for all work. For details, see Lehoux, 2000, p. 148-150.

12 See Lehoux, 2000, p. 217 f.

13 On the Ceramicus parapegma, see Lehoux, 2000, p. 61. The Parapegma was originally published by Brückner, 1931. The P. Hibeh parapegma was published by Grenfell and Hunt, 1906, p. 138-157. It dates from c. 300 B.C. For this date, see Grenfell and Hunt, 1906; Neugebauer, 1975; Spalinger, 1991. That this is the oldest extant astrometeorological parapegma depends on the rejection of various modern reconstructions of parapegmata. See Lehoux, 2000, p. 82f., p. 31, and p. 218.

Literary parapegmata work a little differently than the inscriptional parapegmata we have seen. Where the inscriptions used pegs and holes for tracking the current astrometeorological or astrological cycle, textual parapegmata use some kind of calendar to perform the same function. But Greek calendars are notoriously unstable and do not line up with the solar year very well at all from year to year.[14] To get around this, literary parapegmatists use solar calendars such as the Alexandrian and the Julian.[15] So in Ptolemy's *Phaseis* we see:

> [Month of] Thoth
>
> 1st. 14 ½ hours:[16] the star on the tail of Leo rises. According to Hipparchus the Etesian winds stop. According to Eudoxus rainy; thunder; the Etesian winds stop.
>
> 2nd. 14 hours: the star on the tail of Leo rises, and Spica disappears. According to Hipparchus

14 See Samuel, 1972; Pritchett and Neugebauer, 1947.

15 Both the Alexandrian and Julian calendars are 365-days long with a leap year inserted every 4 years. The Julian calendar was inaugurated by Julius Caesar in 45 B.C., and used the traditional Roman month names, but replaced the old *Quintilis* with Julius, and (after A.D. 8) *Sextilis* with Augustus. The Alexandrian calendar was the civil calendar of Roman Egypt. It used Egyptian month names (Thoth, Phaophi, Hathyr, etc.). Each month had 30 days, and there were five "extra" *(epagomenal)* days at the end of the year (or six in a leap year). It was inaugurated in either 26 or 30 B.C. (for the debate around these dates, see Jones, 1999a, vol. 1, p. 12).

Geminus is the exception to the rule that literary parapegmata all incorporate calendars, in that he does not use a calendar at all, but instead uses the sun's motion through the zodiac as an index of the solar year. See Lehoux, 2000, p. 89 f.; Toomer, 1974. Contrast those arguments with the general consensus that sees the zodiacal scheme in Geminus as calendrical: Rehm, 'Parapegma', *RE*; Rehm, 1941; van der Waerden, 1984; Bowen and Goldstein, 1988; and Hannah, 2001b, p. 81 f. Hannah, 2002, is (I think sensibly) more cautious.

16 Meaning "[For the latitude where the longest day is] 14 ½ hours".

there is a change in the weather.

3rd. 13 ½ hours: the star on the tail of Leo rises. 15 hours: the star called Capella rises in the evening. According to the Egyptians the Etesian winds stop. According to Eudoxus variable winds. According to Caesar wind; rain; thunder. According to Hipparchus the east wind blows.

4th. 15 hours: the rearmost star of Eridanus sets. According to Callippus it is stormy and the Etesian winds stop.

5th. 13 ½ hours: Spica disappears. 15 ½ hours: the bright star in Lyra sets in the morning. According to Metrodorus bad air. According to Conon the Etesian winds finish.

6th. 15 ½ hours: the bright star in the southern claw (of Scorpio) disappears. According to the Egyptians mist and burning heat, or rain, or thunder. According to Eudoxus wind; thunder; bad air. According to Hipparchus wind; south wind.

7th. According to Metrodorus bad air. According to Callippus, Euctemon, and Philippus bad air and unsettled air. According to Eudoxus rain; thunder; variable winds.

Here the user, knowing the date, looks up the corresponding astrometeorological situation. On the face of it, this seems simple enough, but how are the associations between the stellar phases and the weather made?

II. Two sorts of observational claim

Sextus Empiricus, in his *Adversos mathematicos,* begins his attack on the astrologers by bracketing off a particular group of practitioners in order to exclude them from his Sceptical assault. These practitioners are those who observe the fixed stars in order to predict the weather (the astrometeorologists). Sextus tells us that they are excluded from his criticism by virtue of their sound methodology: Where the (horoscopic) astrologers that he will be taking to task all base their work in hypothetical (and therefore uncertain) accounts of stellar *causation*, the astrometeorologists distinguish themselves by working strictly from *observation.* As Sextus puts it:

> It now lies before us to inquire concerning astrology, or the mathematical art, [by which I do] not mean the complete practice of arithmetic and geometry taken together ... nor the predictive ability of the followers of Eudoxus, Hipparchus, and other such men, which is also called 'astronomy,' *for this is the observation of phenomena,* as in agriculture and navigation, from which it is possible to foretell droughts and downpours, plagues and earthquakes, and other such atmospheric changes... *(Adv. math.*, V.1-2, italics mine.)

Since the correlations drawn by the astrometeorologist between stellar phases (the annual risings and settings of the fixed stars) and weather are *observational*, rather than theoretical, Sextus—known as *Empiricus,* after all—has no objection to them.

And Sextus is not the only source to make a claim for the observational foundation of astrometeorology. We find a strong observation claim as well in Geminus:

> The actual predictions of changes in the weather in the parapegmata do not happen because of some kind of regular rules, nor are they calculated by some craft, [as if] the effects of the stars were constrained. Rather the harmony was perceived by daily observation of what generally happens, and [someone] wrote it down in parapegmata. (*Elem. astr.* 182.6 f.)[17]

So also Ptolemy tells us that the weather predictions in his *Phaseis* are derived from observation, and he even tells where each of his observers did their observing:

> ...and (regarding) those (authors) who wrote down the changes in weather, different ones happened to observe in different places, and to be in altogether different climates... *(Phas.* 11.19 f.)

And later,

> ... the Egyptians observed here; Dositheus in Cos; Philippus in the Peloponnesus, Locris, and Phocis; Callippus in the Hellespont; Meton and Euctemon in Athens, the Cyclades, Macedonia, and Thrace; Conon and Metrodorus in Italy and Sicily; Eudoxus in Asia, Sicily, and Italy; Caesar in Italy; Hipparchus in Bithynia; and Democritus in Macedonia and Thrace. *(Phas.* 66.23 f.)

In the modern secondary literature, we also find frequent, if casual, acceptance of the centrality of observation in the parapegmatic tradition.[18] But we would do well here to distinguish two different senses of *observation* in this context. The observation claim as we find it in the ancient texts (and a few modern ones)[19] works as part of the epistemological *justification* of astrometeorology, by presenting a core of empirical data that the tradition is supposed to be based on. In this sense, observation is central to the original correlation between particular stellar phases and particular weather predictions: this stellar phase and this weather phenomenon were observed to coincide, at some historical point in time, by such-and-such an authority. This is how the ancients understand the attributions *"according to x"* that we find so commonly in parapegmata.

The second sense of observation is confined to the modern literature, and has to do with the actual *use* of parapegmata. Unlike Douglas Adams' famous package of toothpicks, ancient parapegmata do not come with instructions for use. But how they were used seems on the face of it simple and obvious. Modern authors generally suppose that an astronomer, or at least an astronomically aware observer, would go out on a particular night or morning and observe any stellar risings or settings of note. He or she would then turn to a parapegma where the observed stellar phase would be looked up and the weather prediction read off.

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17 One reader wondered whether Geminus' claim that the data in parapegmata are not calculated by a "craft" (τέχνη) might be a way of demoting astrometeorology as a form of knowledge. In the context of Geminus' argument, though, I think this is not the case. Geminus is never the most philosophically careful of writers and I think that τέχνη slips in here rather innocently. He seems only to be drawing a contrast between theoretically and observationally derived correlations. His argument in the chapter is designed to reject a theoretical correlation between stars and weather as unfounded. He does not, however, reject the observational correlation, nor does he seem to try and demote it as a kind of knowledge.

18 See, e.g., Hellman, 1917; Rehm, 1941; van der Waerden, 1949; van der Waerden, 1985; Hannah, 2002.

19 Hellmann, 1917 and Leitz, 1995 both depend for much of their readings on the assumption of an original observational correlation between stellar phenomena and weather. See also van der Waerden, 1984.

For example, in arguing that the parapegmata use apparent rather than true phases, Bowen and Goldstein say:

> ...given that the practical value of a parapegma lies in its treating astronomical events at the horizon as signs or indicators and correlating them with meteorological changes (the *significata),* it would be odd to introduce theoretical and, hence, unobservable events as signs. Moreover, the literary tradition which lies behind and is the context of the invention of the parapegmata is limited to relating the weather to *visible* astral horizon-phenomena.[20]

And other examples of explicit or implicit acceptance of the idea that the observation of stars is somehow central to the use of parapegmata are common.[21] We need to keep this *practical* observation claim distinct from the *foundational* observation claim we find in the ancient literature, and we shall look at each of these two claims in turn. As we shall see, the practical observation claim has trouble sustaining itself when we turn to look at how parapegmata were used. This is because the model of prediction assumed by modern historians, in which daily astronomical observations were referenced to astrometeorological texts in order to derive day-to-day weather predictions, turns out to be impractical for parapegmata (although it does work well for texts like Hesiod). There are some interesting problems around the foundational claim as well, in that the foundational observational correlation of phase and weather is not possible without a prior

[20] Bowen and Goldstein, 1988, p. 54, italics theirs. For the argument against this, see Lehoux, 2000, p. 12-13.

[21] Hannah, 2001a; Evans, 1998, p. 6-7, 190-1 (but contrast p. 201); Rehm, 'Parapegma', *RE;* Rehm, 1941. Hannah, 2001b, p. 62, 74 f. and Hannah, 2002 describe parapegmata as tools for ordering "observations."

schematization of the stellar phases.

III. Watering down the foundational observation claim

Let us begin by looking at the foundational observation claim. It turns out that, for the astrometeorological parapegmata it is, at a very basic level, technically impossible. One simply cannot observe the co-incidence (in the literal sense of that word) of the morning rising of Arcturus and a rainstorm. The rain precludes the possibility of making an astronomical observation that day. That being said, a watered-down version of the observational correlation can be maintained if we presume the astronomical cycle to have been at least partially canonized first. Once we have ordained a sequence of stellar phases for the year, with at least a rough idea of the date differences between them, then one rainy morning we can observe the weather and, consulting our scheme for the sequence of stellar phases, associate the weather with the stellar phase that we know from the text should be happening today. We see something of this kind happening in a handful of cases in the astrometeorological sources, such as Ovid:

> When it is the Nones [of January (i.e., Jan. 5)], the rains sent to you from dark clouds will give the sign that the Lyre is rising. *(Fast.*, I.315)[22]

So, too, Pliny says that we can tell "from storms that a star is completing (its phase)" at the equinoxes *(NH,* II.108).

Of course this watered-down foundational observation claim is complicated by the evidence from some parapegmata that weather could be associated with a stellar phase a few days before or after. See, for example, Geminus:

[22] Compare also IV.901 f.

> Often (the parapegmatist) has marked a change in the weather[23] with the rising or setting of a star three or four days too late, and sometimes he has anticipated the change by four days. *(Elem. astr.* 188.18 f.)

In the Aëtius parapegma[24] there is a similar flexibility with regard to the temporal sequence of weather and phase, and Columella tells us that "the force *(vis)* of a star is sometimes before, sometimes after, and sometimes on the actual day of its rising or setting" *(RR*, XI.i.32). While these passages would admittedly let us make some actual observations of the delayed coincidence of a stellar phase and a weather phenomenon, they are notably not the usual association made in the parapegmata, and I think serve as the exception that proves the rule.

But such examples alert us to one other possibility for the correlation between weather and stellar phases, what we might call *observational interpolation:* a Euctemon or a Callippus may miss the exact day of the morning rising of Arcturus, but when the sky finally clears the next day or the day after, they can see that Arcturus is then too high in the sky to just be rising for the first time that day. So the actual date of the rising of Arcturus could then be interpolated back to a day or two earlier, and the correlation thus made through observational interpolation. But again, this is a watered-down version of the kinds of strong observational claims we see in Sextus and Geminus.

Thus a strong foundational observation claim is, strictly speaking, not tenable. Nevertheless, we can argue (I think plausibly) for a watered down version of such a claim, but this can only work if we presume (a) a prior schematization of the annual

[23] ἐπισημαίνει is here being used in an extended sense meaning 'to mark an ἐπισημασία.' The grammar of this sentence is odd, but the sense is clear. See Lehoux, forthcoming.

[24] Published in Wachsmuth, 1897, p. 295-299. See also Lehoux, 2000, p. 39-40.

sequence of phases for a given latitude, and/or (b) an interpolation of phases from different observed positions of stars relative to the horizon several days apart. That (a), (b), or both—and I suspect it is both—must hold can also be seen by the consideration that in no single year will an observer be lucky enough to get a string of uninterrupted observations of phases. Weather must intervene from time to time, forcing the events unobservable this year to be interpolated, or inserted from a different year's observations. But we should keep in mind that by thus watering down the foundational observation claim, we are simultaneously—and to the same extent as we watered down the claim—moving away from any strict definition of the word *observational.*

Ptolemy himself seems to recognize something of the sort in his discussion of the calculation of stellar phases for each of the different latitudes. In both the *Phaseis* and the *Almagest,*[25] he admits that his values for the order and timing of the stellar phases for each latitude are based on calculation. When he lays out the method for this calculation in the *Almagest,* he argues that, although in a perfect world he *would* make or collect observations of each star at each latitude, in practice he can do little better than to make observations from one latitude and trust that the results are in fact generalizable. He then gives the geometrical construction and method by which such generalizations could, in theory, be calculated. But then he admits that even this method is still too cumbersome to be practical, and that he will be satisfied to use the records of his predecessors, and/or a celestial sphere to compute the phases for the different latitudes.

[25] Ptolemy, *Phas.* p. 3-4; *Alm.* VIII.6.

IV. Problems with the practical claim

Now to the practical claim. Let us look again at the structure of a parapegma. In every parapegma astronomical, astrometeorological, or astrological information is *indexed* to some date-marking function. In an inscriptional parapegma, this date marker is the peg itself, which by its very presence acts as a temporal "you are here" marker for the astrometeorological or other cycle tracked by the parapegma. In a literary parapegma, the cycle is indexed to a calendar. So, depending on the type of parapegma, by either (a) knowing the date, or (b) glancing at the entry beside the peg, the astronomer is able to look up the current astrometeorological situation in a parapegma. To see this, look at the purely astronomical inscriptional parapegma *Miletus I*:[26]

- The sun is in Aquarius
- [.....] begins setting in the morning and Lyra sets. ● ●
- Cygnus begins to set acronychally. ● ● ● ● ● ● ● ● ●
- Andromeda begins rising in the morning. ● ●
- Aquarius is in the middle of rising.
- Pegasus begins to rise in the morning. ●
- The whole of Centaurus sets in the morning.
- The whole of Hydra sets in the morning.
- Cetus begins to set acronychally.
- Sagitta sets, the season of the west wind accompanying. ● ● ● ●
- The whole of Cygnus sets acronychally.

If the practical observation claim were correct, we should see the astronomer observing a stellar phase and then consulting this parapegma to—do what? Find the peg? Obviously not. Move the peg? No. The peg was simply moved from one hole to the next each and every day. Instead it is the *peg* that was looked for—we should properly say *observed* here—by the user of the parapegma, and the astronomical situation was then read from beside it. Quite the contrary to the practical observational claim, what the parapegma does is to obviate the need for astronomical observation. What is being observed in practice is instead a peg.

So also in literary parapegmata, the calendar functions in place of the peg. Knowing the date, the user looks up the astrometeorological situation. The very organization of the parapegma, with the stellar phases and weather indexed to the calendar, shows that it was via the calendar that the astrometeorological situation was referenced. To see this, let us imagine a user making an observation of, say, the morning rising of Arcturus (let's assume from a Clima of 14 ½ hours), and then trying to find that phase in a parapegma like Ptolemy's. We can see just how difficult it would be to find anything. Look at the following eight-day excerpt from the month of Thoth in Ptolemy's *Phaseis* (Thoth 23-30):

> 23rd. 14 ½ hours: the star called Capella rises in the morning. 15 ½ hours: Arcturus rises in the morning. According to the Egyptians drizzle and wind; there is a change in the weather. According to Callippus and Metrodorus, rainy.
>
> 24th. 13 ½ hours: the star shared by Pegasus and Andromeda sets in the evening.
>
> 25th. 13 ½ hours: the bright star in the southern claw disappears. 15 hours: the bright star in Cygnus sets in the morning. According to the Egyptians west wind or south wind, and thunder storms throughout the day.
>
> 26th. 15 hours: Arcturus rises in the morning. According to Eudoxus rain. According to

[26] Published by Diels and Rehm, 1904; Dessau, 1904. The text here is based on my new edition of the fragments currently under preparation.

Hipparchus west wind or south wind.

27th. 14 hours: the star shared by Pegasus and Andromeda sets in the morning, and the rearmost star of Eridanus sets in the morning.

28th. Autumnal equinox. According to the Egyptians and Eudoxus there is a change in the weather.

29th. 14 hours: the star called Antares disappears. 14 ½ hours: Arcturus rises in the morning. According to Euctemon there is a change in the weather. According to Democritus rain and unsettled winds.

30th. 14 ½ hours: the star shared by Pegasus and Andromeda sets in the morning. According to Euctemon, Philippus, and Conon there is a change in the weather.

It quickly becomes apparent just how impractical the practical observation claim is.

Another important clue that it is dates and not astronomical phenomena that are 'observed' by the user can be seen at Thoth 7 (quoted earlier). In its entirety, it reads: "According to Metrodorus bad air. According to Callippus, Euctemon, and Philippus bad air and unsettled air. According to Eudoxus rain; thunder; variable winds." We see that on this day we can expect one or a combination of (a) bad air, (b) unsettled air, (c) rain, (d) thunder, and (e) variable winds. But these are all indexed to the date *only*. There is no astronomical phenomena that they are tied to at all, so any observation we may or may not have made that day is irrelevant to actually finding this entry. And by the time of the *Polemius Silvius Fasti*,[27] (5th c. A.D.) the stellar phases have dropped out of the parapegma entirely and *all* the meteorological entries are indexed to dates alone.

[27] Published in Degrassi, 1963, vol. XIII.2, p. 263-276.

What the parapegma does is to canonize a temporal cycle (astronomical, astrometeorological, astrological) in its entirety, one event after another, and then to provide a handy means (the peg or the date) of locating ourselves in that cycle. It tells us where we are in the year, for example, and it associates the different temporal locations in that cycle with both stellar phases and weather.[28] But the associations of stellar phases with dates, once thus canonized, are no longer associations referenced by stellar observation, but are instead *normative* statements that particular events, stellar and/or meteorological, happen on particular days or in a particular order, and the instrument itself now serves as the tool for locating ourselves in that cycle.

Now, saying that the day-to-day use of parapegmata does not depend on observation is *not* to say that astronomical observation goes out the window entirely. On the contrary, it does still have some roles to play. For example: observation can confirm or check the content of a parapegma, and observation is importantly used to calibrate parapegmata from time to time,[29] and

[28] For the most part, these cycles are not civic or religious. The use of civil or other calendars only occurs in place of the peg in literary parapegmata as a handy way of locating the current day. Most astrometeorological parapegmata do not mention religious or civil cycles at all. The one obvious exception to this is P. Hibeh 27 (published in Grenfell and Hunt, 1906, p. 138-157), which correlates both astrometeorology and Egyptian religious festivals with Egyptian civil dates. On the other hand, Roman inscriptional parapegmata do often include hebdomadal and nundinal cycles (the Roman seven- and eight-day "weeks," on which, see, e.g., Michels, 1967), and some also track civil calendrical cycles as well (see Lehoux, 2000, p. 45-54; 62-3). On the relations between Roman civil and religious cycles generally, see Salzman, 1990.

[29] The frequency of calibration depends on the type of parapegma. For astrometeorological parapegmata, this was probably once per year or less. For astrological parapegmata, lunar phenomena may need calibrating once every month or two. Parapegmata indexed to the Julian and Alexandrian calendars, however, were meant to be self-calibrating, as Ptolemy tells us at *Phas.*, 10.5 f. See also Lehoux, 2000, p. 102-108.

observation can serve (as it does in Hesiod and Aratus, for example) when there is no parapegma around, but observation is basically superfluous in the day-to-day use of a parapegma.

V. How signs are observable

Look back now at the passage from Bowen and Goldstein that introduced us to the practical observation claim initially:

> ... it would be odd to introduce theoretical and, hence, unobservable events as signs.[30]

It turns out that their central claim holds after all, although we find that we must redirect their conclusion. It *is* true that unobservable (in the sense of imperceptible) events cannot function as predictive signs, since a sign that is imperceptible-in-principle could offer no way of feeding itself in *(qua* sign) to a predictive calculus.[31] There is simply nothing to draw a conclusion from, if nothing has been perceived. This is an important point, and Bowen and Goldstein hit it square on the head. An invisible sign is no sign at all.

But we cannot conclude from this that the signs used to draw predicted conclusions in parapegmata must have been *observed stellar phases* specifically. We have already seen that predictions are arrived at from parapegmata by observing either the peg or the date, not by observing the stars. And since the peg or the date is what is observed in making the astrometeorological prediction, then it is the peg or the date that, properly speaking, functions as the *sign* in the predictive calculus. And that sign is, after all, observable.

[30] Bowen and Goldstein, 1988.

[31] On predictive signs, see Lehoux, 2000, chapter 5.

VI. The move from practical to theoretical sign in astrology

I remarked earlier that the practical observation claim does still seem to hold up when dealing with texts such as Hesiod, where the astronomical phenomena associated with the weather are not indexed to a day or date marker. From both the structure of the poem and the paucity of astronomical phenomena to watch for, it seems that to follow Hesiod's advice is simply to remember a few rules of thumb, and to call them to mind when one knows (through observation or otherwise) that a phase is occurring. But by the time we start to see full-blown parapegmata, something has changed, in that the users no longer work primarily from astronomical observation. The instrument itself, by canonizing the entirety of a very detailed cycle, quietly moves us away from the observational to the instrumental. I say quietly here just because the working of the parapegma is always understood by its users as relating *actually occurring* stellar phases with weather. The stellar phase functions as a kind of sign, but now only a sign-in-theory. The fact that the user no longer needs to make observations of those actually occurring phases goes unremarked by the ancient authors. And this shift is not unique in the parapegmatic tradition. Other examples are easily found. Take for example Greek horoscopic astrology, where the stars are seen as conditioning the character of an individual by their positions at the time of her birth. To predict a significant event in her life, the astrologer looks at the configuration of the sky at her moment of birth, and then furnishes predictions based on that configuration. Just as with astrometeorology, the ancients assume that the configuration they are using to make their predictions is an *actual* configuration. But of course it is not. It is rather a *calculated*—retrodicted, to be specific—configuration.[32] What is observed by the astrologer is not the stars, nor even old observational reports of the stars, but is

[32] See Jones, forthcoming.

instead a set of tables of one sort or another[33] which then determines for the astrologer what the positions of the planets had been at a particular instant in the past.

Of course, this was not always the case. In the earliest astrological texts (usually referred to as 'astral omens' to distinguish them from horoscopic astrology) the astronomical phenomena were not yet predictable. Look at the following example from tablet 59 of the second-millennium-B.C. Mesopotamian astral omen collection *Enūma Anu Enlil*:[34]

> If Venus rises in the month of Tammuz and Gemini stands in front of it, the king of Akkad will die.[35]

Here we see an observed sign (Gemini in front of a rising Venus in the month of Tammuz) correlated (possibly via a claim of historical precedence) with a prediction.[36] We presume some trained observer looking at the sky with an eye open for signs of this kind. Early one morning, our observer sees the signature conjunction of Venus and Gemini at Venus' rising and, knowing his or her way around *Enūma Anu Enlil,* looks the observation up in the text to see what it portends. Schematically, we have the

[33] For a description of the types of table used in the Greek astrological tradition, see Jones, 1999b; Jones, 1999a, p. 113-119, 175-177, 231; Jones, forthcoming.

[34] For the relationship between Mesopotamian astral omens, astrology, and astronomy on the one hand and Greco-Egyptian astrology and astronomy on the other, see Barton, 1994; Evans, 1998; Neugebauer, 1975; Jones, 1999a, p. 15-34.

[35] *EAE* 59-60.IV.2, text in Reiner, 1998, p. 118. Translation mine.

[36] On precedence in the omen tradition, see Lehoux, 2002. The question of whether observations were systematically collected in Mesopotamia for the development or improvement of the omen tradition tends to be centred on the role of the so-called 'Astronomical Diaries'. See Sachs and Hunger, 1988; Lehoux, 2000, p. 184-185; Swerdlow, 1998; Slotsky, 1997; Hunger and Pingree, 1999, p. 139-140.

following situation:

(1) Observed Sign —(rule)→ Prediction
Observed conjunction —(omen text)→ Death of the King

But at some point around the fifth century B.C. (give or take, depending on the phenomenon and method of prediction in question) the sign in the protasis of the astrological omen—and this is generally true only of the astrological omen[37]—became itself the subject of a second-order prediction. Mesopotamian astronomers were now able to predict the conjunction of the rising Venus with Gemini.[38] This adds another layer of complexity to the astrological prediction. We now have a two-step predictive process. In the first step, the astrologer is predicting what used to be the protasis of the omen: the conjunction of Venus and Gemini, and in the second step is then shifting the results of that prediction back into the protasis of an omen to furnish a final apodosis: the death of the king.[39] But how do we get the first of

[37] To be sure, there are some other kinds of omen apodoses that themselves serve as protases of other omens, for example some liver omens predicted eclipses (e.g., *Manzāzu* tablet 3.26 in Koch-Westenholz, 2000), which were in turn ominous events that portended doom for kings and such. And while I insist that such examples are not trivial, it is only with astral omens that a significant number of protases become predictable, and it is only in astrology that this predictability is mathematical.

[38] See Koch-Westenholz, 1995, p. 51-52. I am deliberately sidestepping the controversial question of the relationship between Mesopotamian astronomy and Mesopotamian astrology. We know surprisingly little for certain about whether or how the well attested mathematical astronomical methods were used by astrologers and diviners. For a sense of the current state of the question, see Rochberg, 1999.

[39] Modern scholars generally believe that Mesopotamian astral omens still relied on the *actual* observation of a predicted eclipse for it to have ominous significance, and that unseen eclipses were not ominous. Nonetheless, there are a few letters and reports (e.g., Parpola, 1993, no. 114; Beaulieu and Britton, 1994) which show that precautionary measures were taken (i.e., the appropriate *namburbi* ritual was performed, on which, see Caplice, 1974) even

these two predictions, that of the conjunction of the two heavenly bodies? As with astrometeorology, it is through the consultation of texts of one sort or another.[40] Comparing this with the astrometeorological texts we have been looking at in this paper, we see that the old Greek astrometeorological situation (e.g., Hesiod) is structurally identical with the first-order predictions of the old Mesopotamian astral omens:

(1) Observed Sign —(rule)→ Prediction
Observed rising of the Pleiades —(Hesiod's rule of thumb)→ Good time to harvest

But when the signs themselves become predictable, as in both parapegmata and horoscopic astrology, we see the now-predicted sign assume a new place in this scheme, and a new observed sign take over the initial position:

(2) Observed Sign → Predicted Sign —(rule)→ Prediction
Observed Table → Predicted Eclipse —(omen text)→ Death of King

Or for parapegmata:

(2a) Observed Sign → Predicted Sign —(foundational "observational" correlation)→ Predicted Weather
Peg (schematically situated) → Stellar Phase —(according to *x*)→ Predicted Weather, or
Date (legislated) → Stellar Phase —(according to *x*)→ Predicted Weather

when the predicted ominous event was not seen locally. On calculated vs. observed eclipses, see Sachs and Hunger, 1988; Koch-Westenholz, 1995, p. 51-52; Hunger and Pingree, 1999, p. 154-156.

[40] For my purposes here, anything from the relatively simple goal-year texts to the complex mathematical ephemerides count as second-order predictive texts (for a good description and samples of the different types of Mesopotamian astronomical text see Hunger, 1999 and Evans, 1998, p. 312 f.).

where the Stellar Phase is now a sign only *in theory*—but not in actual practice—of the weather predicted.

How significant a change is this for the practitioners? We might expect that the shift from random to predictable signs would have wide-ranging conceptual ramifications for the cosmologies of the astrologers. And some scholars have made just this claim. Speaking of the impact in Mesopotamia, Koch-Westenholz, for example, has said that "we have here what may well be the earliest documented instance of a scientific revolution,"[41] and she thinks the change in question had the cosmological implication that "celestial phenomena could no longer be regarded as willed communications from the gods, and the old idea, that 'signs' in heaven correlate with events on earth, was abandoned."[42] The major problem with this claim, though, is that there is no historical evidence for it. The Mesopotamian sources make no comment on this supposedly major cosmological shift, this "scientific revolution." This in itself would perhaps not be surprising to those familiar with Mesopotamian divinatory texts, who know how notoriously sparse in cosmological, religious, philosophical and epistemological commentary these texts are. But in the parallel case of the Greek astrometeorological tradition, which underwent a structurally identical shift, we see not only no contemporary comment on the cosmological significance of the shift, but—what is worse—we find that after the shift the emphasis on observation by authors like Ptolemy and Sextus show that the fact of the change itself was suppressed. It is not just that they did not remark that a change had taken place (absence of evidence is not evidence of absence), but that they implicitly deny it.[43]

[41] Koch-Westenholz, 1995, p. 52.

[42] Koch-Westenholz, 1995, p. 51.

[43] Whether the insistence on observation was intentionally misleading (perhaps to give astrology a more empirical authority?), or whether it was simply what I have elsewhere called "sloppy empiricism", I leave as an open question.

All this serves to show one of the ways in which the rhetoric and theory of ancient astrology are distinguished from the practice after the signs themselves become predictable.[44] Although the theoretical signs associated with predictions are the astronomical phenomena, the practical signs—the things actually looked at by the astrologer in working out his predictions—turn out to be texts, tables, and instruments.

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[44] As one referee pointed out, in some instances it may be tempting to see the split between rhetoric and practice as at least partly attributable to different levels of expertise among practitioners. An astronomically sophisticated astrologer like Ptolemy will of course have a different (and probably more nuanced) idea about how observation works in astrology than a run-of-the-mill marketplace astrologer would. The evidence I have been adducing in this paper comes mostly from the more theoretically sophisticated practitioners, largely because the simpler practitioners left little more than scraps of horoscope fragments (see Neugebauer, 1987; Jones, 1999a) or equipment (like astrological boards: see Evans, 2004) with no theoretical commentary.

There is a second level of expertise in the sources I have been using, and that is philosophical. Here we see the continuum run from Sextus at one end (philosophically sophisticated, astronomically (probably) naïve) to Ptolemy (astronomically sophisticated, philosophically less so, but see Taub, 1993) with Geminus—straining my continuum metaphor a little—as fairly conversant with general astronomy, but not particularly philosophically showy. And all three of these sources, interestingly, make essentially identical foundational observation claims.

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